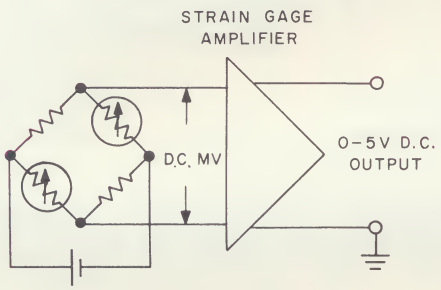
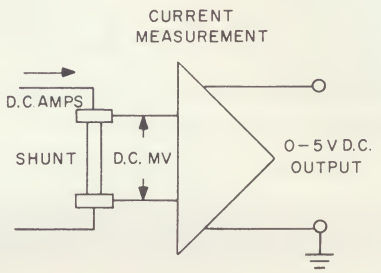
SIGNAL-CONDITIONING AMPLIFIER

Highly reliable solid-state dc amplifier isolates and standardizes transducer output for use in telemetering, transmission, recording or display. This low-cost 400 CPS powered amplifier features input null stability of 0.5 microvolt/°C and gain stability of 0.01% per degree C.



FLOATING INPUT

Strain-Gage Amplifier: Extremely high rejection of common mode interference by the MAS50 enables it to operate with a floating input circuit, as in strain gage applications. The signal, after conditioning by the amplifier, can be multiplexed with other conditioned signals because any number of MAS50's can share a common ground at their outputs.



HIGH-SIDE MONITORING

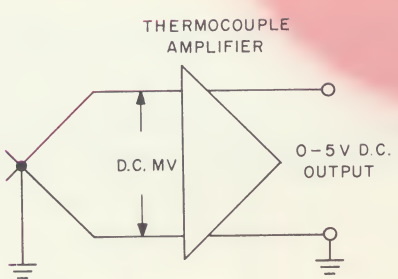
Current Measurement: Having its input well insulated, the MAS50 can be connected across a shunt in the high side of a line if necessary. For example, measurement of the plate or screen current of a power tube operating at high voltages can be done with the case of the MAS50 grounded.

$157 EACH

(1 to 6 pieces)

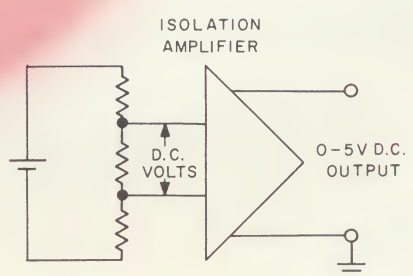
TYPE MAS50

Delivery from stock



ISOLATION OF GROUNDS

Thermocouple Amplifier: In applications such as amplification of a thermocouple output, the MAS50 combines inherently stable high gain with negligible drift in zero offset. Because input and output are electrically isolated from each other, the input can be either grounded or ungrounded while the output has one side grounded. Calibration of thermocouple lead length is unnecessary in normal-length runs because amplifier input resistance is much higher than thermocouple resistance.



SCALE CHANGE

Isolation Amplifier. Basically the MAS50 is an active 4-terminal device that produces 0 to +5 vdc output from a 0 to 50 microampere input. The amplifier provides a change of scale and of zero in several ways: by using a resistance in series with the input, by choice of a voltage gain of 1 or of 100 within the amplifier and by a bias current through the auxiliary winding. A screwdriver adjustment on the amplifier changes the gain by about 20% to calibrate the scale change and to compensate for tolerance in metering circuits.

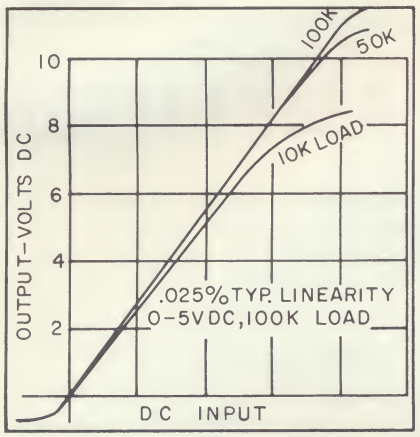


Figure 1 — Output Characteristics

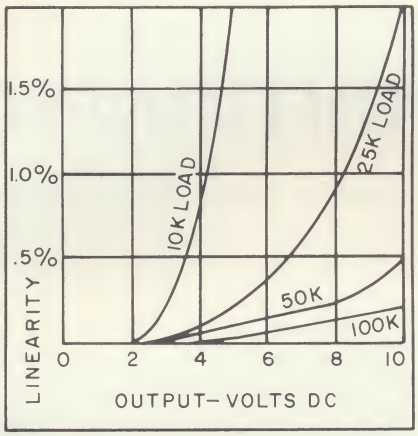


Figure 2 — Linearity

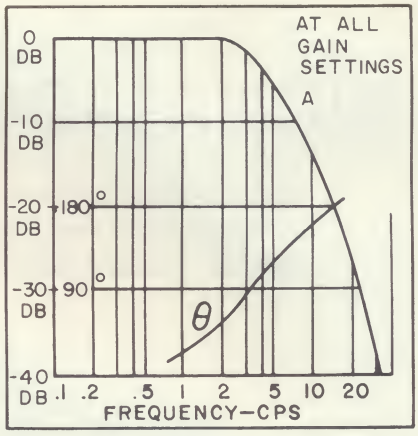


Figure 3 — Frequency Response

TYPICAL CHARACTERISTICS

The Airpax MAS50 signal-conditioning amplifier is basically a direct current sensing device having a full-scale sensitivity of + 5 volts dc output for a 50 microampere input. By addition of series resistance in the input circuit, it serves also as a voltage amplifier.

When operating into a 100K load, the amplifier produces an output voltage that is linear with input current, for a typical unit, within 0.025% of full scale. The accompanying graph of output characteristics (Figure 1) shows this performance and indicates the effect of decreasing the load resistance below the recommended value. Internal output resistance of the amplifier is typically in the vicinity of 1K. As a voltage amplifier, an input of as little as 50 millivolts produces the full-scale output of 5 vdc, giving a gain of 100. Because external series input resistance can be used to make the gain any value less than 100, the graph of gain is presented without a scale for the abscissa.

Effect of load resistance on linearity is shown in greater detail by the direct plot of linearity in percent of full-scale output voltage (Figure 2). Above the rated output of 5 vdc, the amplifier begins to saturate, and thus protects circuits and equipment that follow from excessive overload in event of an unexpectedly large excursion of the input.

SIGNAL LIMITING

The signal-limiting characteristic (Figure 1) of the amplifier has several other desirable features: polarity reversal of the input does not damage the amplifier and causes only a small negative output (less than a volt regardless of the amplitude of the negative drive). The input winding can withstand 500 times its full-scale current. In addition to the protective advantages of this characteristic, the limiting feature facilitates scale expansion for the monitoring of a narrow range of a dc input with full-scale accuracy. When the input moves out of the range of interest, the limiting characteristic of the amplifier prevents the large change from over-modulating a telemetering channel or from driving a recorder or

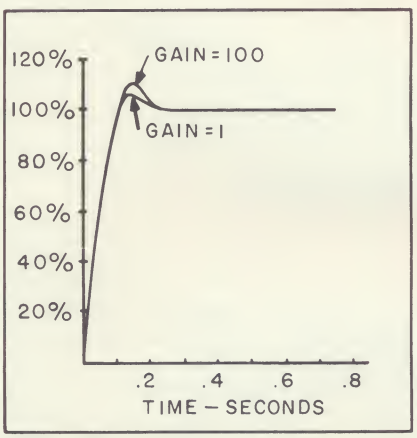


Figure 4 — Step Response

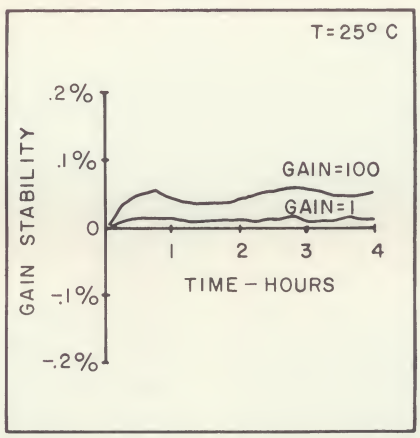


Figure 5 — Gain Stability

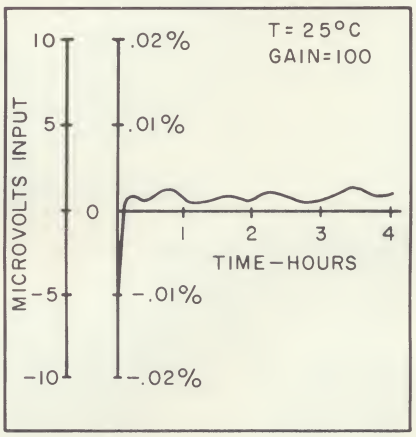


Figure 6 — Zero Dc Stability

indicator too hard into its stops. The limiting feature also enables the amplifier itself to withstand, without damage, a short circuit across its output. A zener diode limiter can be connected across the output of the amplifier if more abrupt output limiting is needed.

Amplifier response is substantially flat from 0 to 2 cps and is down 6 db at about 6 cps (Figure 3). In terms of transient response, steady-state output is reached about a quarter of a second after a step input (Figure 4).

Low drift and stable gain of the Airpax MAS50 are partly the consequence of inherent reliability of the magnetic amplifier and partly the result of refined design and controlled manufacture. Gain of a typical unit remains within 0.1% of its average value with a ±10% change in line voltage, and remains within 0.15% of its average value with a change in environmental temperature from +20°C to +45°C. Under standard conditions (115 vrms line voltage and 25°C ambient temperature), gain fluctuates only slightly with time (Figure 5). Equally important, the zero dc level, expressed in terms of an input signal that would produce the observed fluctuation, remains very stable with time (Figure 6).

COMMON MODE REJECTION

The Airpax MAS50 is used as a dc-to-dc differential input amplifier wherever you need to convert a transducer signal (current or voltage) to a standard output range of 0 to +5 vdc. Typical applications of this plug-in hermetically sealed unit include instrumentation for telemetering and recording. Its narrow-band response aids in rescuing low-frequency analog data mixed with spurious high-frequency interference. Being rugged in construction and reliable in operation, the Airpax MAS50 amplifier can be designed into systems that require operation for long periods with a minimum of attention.

Of particular design significance is the differential input. Construction of this Airpax amplifier provides 100 db minimum common-mode rejection of signals, even those having amplitudes in the vicinity of 100 volts. In a typical Airpax signal-conditioning amplifier, common-mode rejection is 140 db at dc, 120 db at 60 cps, and 140 db at 400 cps. Such rejection would be difficult to accomplish if attempted in other ways. For example, whereas the common-mode rejection of a transistorized differential amplifier is limited to voltages within the range of the bias supply, typically ± 10 vdc, in the Airpax magnetic amplifier the only limitation is the dielectric strength of the signal winding insulation, which is tested at 500 vdc to assure satisfactory continuous operation in the presence of common-mode signals up to 100 volts. The input winding (shown in the connection diagram) is isolated both from the power line and from the output. Thus, the input signal can be either from a floating source or from a grounded source, balanced or unbalanced to ground. The isolation between input and output enables this amplifier to couple signals that share no common ground into a common transmitter or recorder.

AMPLIFIER GAIN

Two amplifier inputs provide a voltage gain of either 100 (pins 4 to 3) or 1 (pins 10 to 3). This choice, in combination with your design choice of an external input series resistor enables you to produce standardized telemetering signals in the high-level, 0 to + 5 vdc, range from any of a wide variety of inputs.

Design of an input network to give a desired over-all gain is based on the following considerations. Internal input resistance of the amplifier is 1K (pins 4 to 3). The added external series resistance is chosen to bring the total resistance to a value that will permit 50 microamperes to flow through the amplifier input when the signal source is at full scale.

For example, if a voltage gain of 20 is desired (so that an input of 250 millivolts will produce full-scale output), 4K of external resistance is added in series with the input. This resistor should be a stable wire-wound or metal-film type with low temperature coefficient to preserve the thermal stability of the amplifier. For a gain of unity, the added resistance is 99K; however unity gain is obtained directly using input pins 10 and 3 which have a built-in resistor. See the terminal connection diagram on the following page.

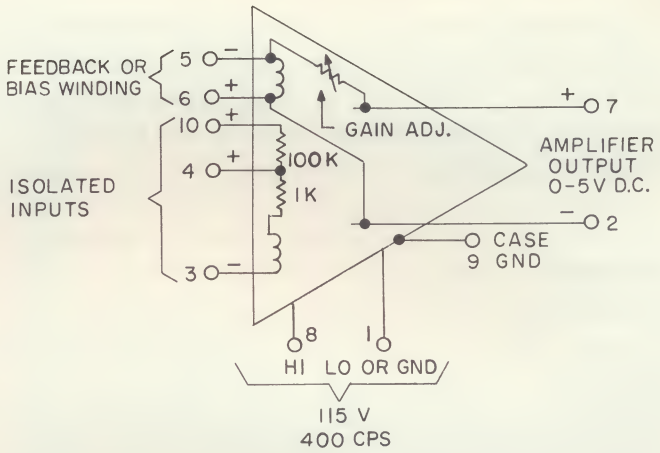
Also built in is a vernier ± 10% gain adjustment. This adjustment further aids in setting each amplifier and its associated circuitry to produce a precisely calibrated output. The adjustment is made by screwdriver setting of a potentiometer shaft that projects through the top of the fully-sealed amplifier can. The potentiometer is in a feedback circuit from the amplifier output (pins 7 to 2) to a separate auxiliary winding, as shown in the terminal connection diagram. The ends of this auxiliary winding (pins 6 to 5) are also accessible for other applications. The winding can be used as a bias winding to elevate the zero of a bipolar signal. For example, if an input has a range of ± 2.5 vdc, by applying current to the auxiliary winding to bring the amplifier output to + 2.5 vdc when the signal is 0, the output range becomes 0 to + 5 vdc. In this example, the amplifier is operated at unity gain; it could equally well be used with smaller signals that could require

gains up to 100. In this or any other use of the auxiliary winding for biasing the amplifier, external series resistance of the circuit connected to the winding (pins 6 to 5) should be 20K minimum.

OPERATIONAL CONSIDERATIONS

Airpax Type MAS50 amplifier has an 11-pin header that mates with any standard 11-pin tube socket (such as Amphenol 77MIP11 or 78S11). The case (pin 9) should be grounded. No special power supply is necessary; the amplifier operates directly from 115 vrms 400 cps single-phase power.

A low ac impedance between the low side of the power input (pin 1) and the low side of the amplifier output (pin 2) is essential for proper operation. This low impedance can be a capacitor (with a capacitance of 0.5 uf or higher). A direct short is best. If complete isolation between power line and amplifier output is needed, insert an isolation transformer between the line and the power input (pins 1 and 8). A single transformer can isolate many amplifiers.



FOR PROPER OPERATION, LOW AC IMPEDANCE(.5uf OR HIGHER) MUST BE PROVIDED EXTERNALLY BETWEEN TERMINALS 2&1. DIRECT SHORT IS BEST, USING AN ISOLATION TRANSFORMER IF ISOLATION IS REQUIRED BETWEEN POWER & AMPLIFIER OUTPUTS.

Terminal connection diagram showing simplified equivalent internal circuit

SUMMARY OF RATINGS FOR TYPE MAS50 SIGNAL-CONDITIONING AMPLIFIER

Voltage Gain: From input terminals 4 and 3 to output terminals 7 and 2, the gain is 100; from input terminals 10 and 3 to output terminals 7 and 2, the gain is 1. A sealed adjustable internal potentiometer accessible from the top of the amplifier can change the gain by ± 10% with a resolution of at least 0.05%. Positive input at terminal 4 or 10 with respect to terminal 3 produces positive output at terminal 7 with respect to terminal 2.

Input Resistance: Internal resistance is 101,000 ohms ± 2% across terminals 10 and 3 or 1000 ohms ± 6% across terminals 4 and 3.

Output Resistance: Internal resistance at levels below rated output is 1500 ohms maximum across terminals 7 and 2.

Linearity: Into a 100K rated load, the input-output transfer characteristic from 0 to +5 vdc output is linear within 0.1% of full scale of the best straight line.

Zero Stability: Under simultaneous changes of ± 10% line voltage and ± 20° C environmental temperature, the null output does not change by more than ± 0.1% of full scale from the null at 115 vrms and 25° C. The null at 115 vrms and 25°C is less than 0.1% of the full-scale output.

Output Ripple and Noise: Peak-to-peak ripple and noise combined produce no more than 0.1% maximum of full-scale output.

Gain Stability: A ± 10% change in power line voltage about a nominal 115 vrms produces a ± 0.15% maximum change in gain at full scale; a change in environmental temperature from +20°C to +45°C produces a ± 0.3% maximum change in gain of full scale.

Frequency Response: Substantially flat dc to 2 cps, 6 db down at nominal 6 cps.

Common Mode Rejection: At dc, common mode rejection is 120 db minimum (tested at 100 vdc); at 60 cps, it is 100 db minimum (tested at 115 vrms); and at 400 cps it is 120 db minimum (tested directly with the 115 vrms 400 cps power supply). Rejection is measured at a gain of 100 by applying the test voltage between shorted input terminals 4 and 3 and output terminal 2.

Insulation Resistance: At 500 vdc between input and output terminals, between input and power terminals, or between output and power terminals, the insulation resistance is 1000 megohms minimum.

Bias Winding: An internal feedback winding, connected through a gain adjustment potentiometer to the output terminals, is accessible at terminals 6 and 5. This winding has a nominal sensitivity such that 100 microamperes through it produces 5 vdc output across terminals 7 and 2. A negative volt-

age applied to terminal 5 with respect to terminal 6 produces a positive output voltage at terminal 7 with respect to terminal 2. A minimum resistance of 20K should be connected in series with terminal 5.

Power Requirements: The MAS50 operates within specifications from 115 vrms ± 10% at 400 cps ± 5% sine wave free of even harmonic distortion, and draws approximately 2 volt-amperes or 1 watt.

Construction: Reactor, transformer, and choke are vacuum varnish impregnated in accordance with MIL-T-27A. Printed circuit is designed and constructed in accordance with NASA MSFC-STD-154. Electrical connections are soldered to NASA MSFC-PROC-158B. Encapsulation conforms to NASA MSFC-SPEC-379.

Temperature: The amplifier is undamaged by storage at −55°C to +100°C; is undamaged by operation between −55°C and +85°C, and is characterized from +20°C to +45°C.

Humidity: The amplifier performs satisfactorily after 10 days of exposure in accordance with MIL-STD-202, Method 106. The finish may suffer minor blemishes but will not display severe rusting or corrosion.

Vibration: The amplifier withstands, without damage, vibration of 10G over a frequency range of 10 to 2000 cps applied along each of three principal axes for one hour along each axis.

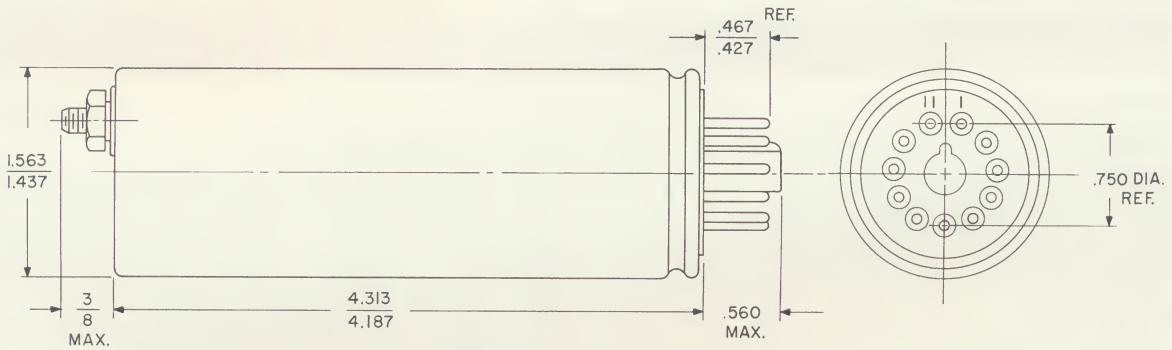
Shock: The amplifier withstands, without damage, shocks of 30G with durations of 11 milliseconds applied three shocks in each direction along each principal axis for a total of 18 shocks.

Header: Terminals pass through compression glass in the hermetically sealed header.

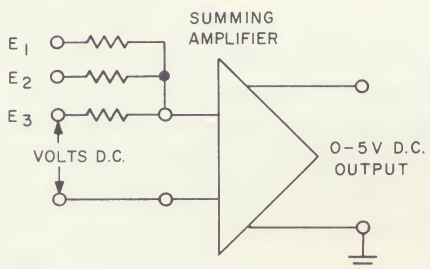
Case: The drawn cold-rolled steel case is protected with electro-tin plating.

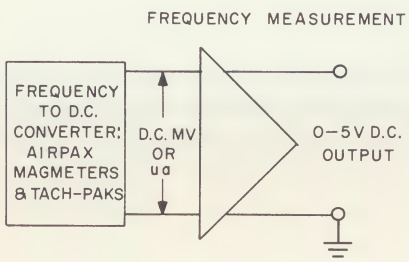
Finish: The case (except for the header) of the amplifier is finished with a zinc chromate primer and a black glycerol phthalate base paint in conformance with MIL-E-5557, Type 4, Instrument.

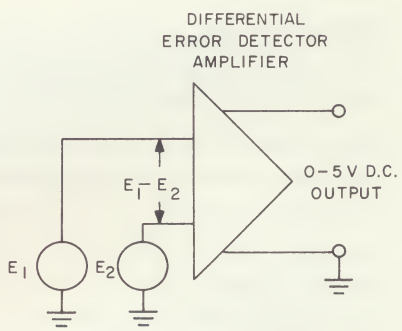
Weight: The amplifier weighs 11.5 ounces maximum.

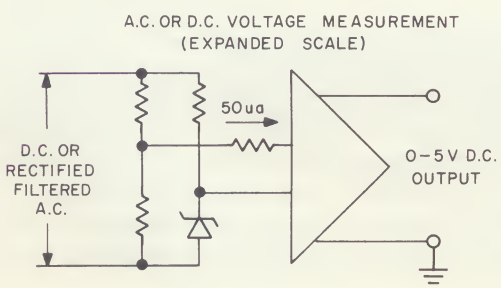


OUTLINE DIMENSIONS OF AIRPAX TYPE MAS50 SIGNAL-CONDITIONING AMPLIFIER

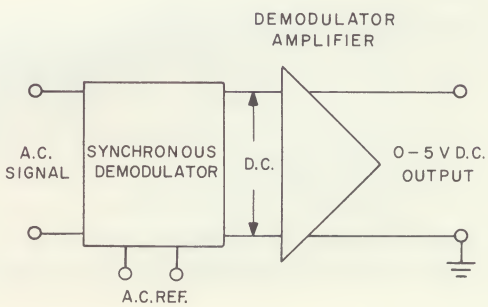








ADDITIONAL MAS50 APPLICATIONS



SEMINOLE DIVISION FORT LAUDERDALE, FLORIDA 33310

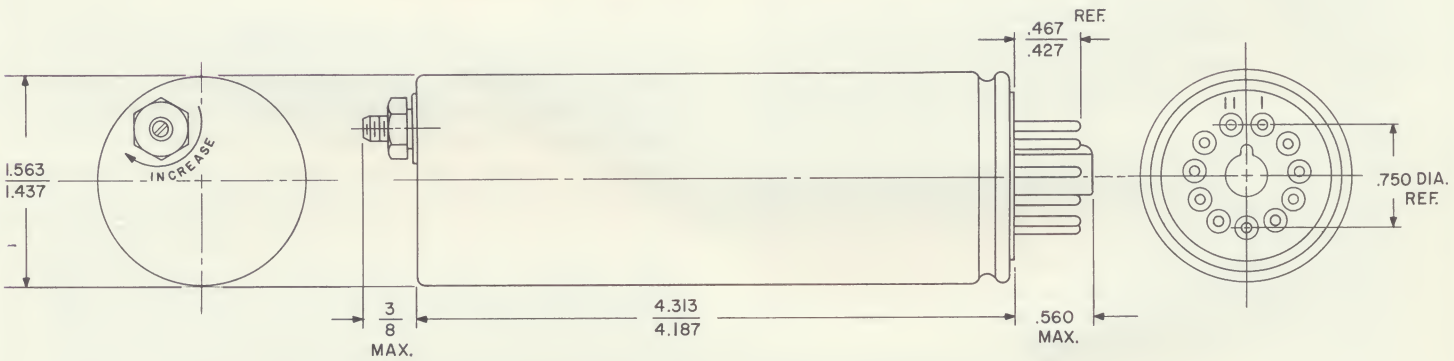
PHONE 305 587-1100 TWX 305 587-1000

AIRPAX

Signal-Conditioning DC Amplifier • Type MAS50

TEST PROCEDURE

Solid-state amplifier provides 5 vdc full-scale output to a 100K load from as little as 50 microamperes through the 1K input. The amplifier has a fully isolated differential input with over 100 db rejection to 100 v common-mode interference.



MEASURE IT . . . it tests within these limits:

Null: Less than ±5 millivolts output for combined changes in power supply voltage from 104 to 126 vrms and changes in ambient temperature from +5°C to +45°C.

Linearity: ±5 millivolts maximum change in output from best straight line.

Gain Stability: 7.5 millivolts maximum change in output for a change in power supply voltage of ±10% from a nominal 115 vrms. 15 millivolts maximum change in output for a change in ambient temperature from +20°C to +45°C.

Output Impedance: 1.5K ohms or less, at or below full-scale output.

Common-Mode Rejection: Less than 10 millivolts output with 100 vdc input; less than 115 millivolts rms output with 115 vrms, 60 cps input; less than 11.5 millivolts rms output with 115 vrms, 400 cps input.

Ripple and Noise Combined: 5 millivolts peak-to-peak output maximum.

Test procedures by which you can accurately verify these characteristics are fully described. Additional characteristics are presented on the back page.

AIRPAX ELECTRONICS incorporated

AIRPAX ELECTRONICS incorporated · SEMINOLE DIVISION, FORT LAUDERDALE, FLORIDA

PHONE: 305 587-1100 TWX: 305 - 587-1000

GENERAL INFORMATION

TEST PROCEDURE • Type MAS50

Airpax signal-conditioning amplifier Type MAS50 has high stability yet low cost. Typical zero stability is 0.5 microvolts per degree C; typical gain stability is 0.01% per degree C. Ungrounded differential inputs provide over 100 db of common-mode rejection to interference even as strong as 100 volts. Two inputs provide a choice of full-scale input sensitivity of 50 millivolts across 1K or of 5 volts across 100K. Intermediate sensitivities are easily obtained by adding series resistance to produce 50 microamperes through the input at the desired full-scale signal. An internal gain trim, externally adjustable, on the hermetically sealed unit provides 20% gain adjustment for calibration of transducer and associated circuits. Full scale output is 5 vdc, single ended. Internal feedback, accessible through auxiliary terminals, can be connected for zero suppression, scale expansion, and similar special signal-conditioning functions. Narrow bandwidth of this dc-to-dc amplifier aids in preserving analog signals from noise. The plug-in unit operates directly from a 115 v, 400 cps power line.

To provide a basis for experimenting with applications of the Airpax Type MAS50 signal-conditioning amplifier and to suggest methods for thorough evaluation of this amplifier, the following test procedure is recommended. Wherever possible, a comparison technique is used to obtain the accuracy and sensitivity necessary for measuring a device with the linearity that is built into this unit.

Comparison of amplifier output against amplifier input gives a direct indication of the critical features of amplifier performance. Instrumentation of this technique is simple to carry out.

TEST SET-UP

In the schematic, regulated variable-voltage power supply, PS1, provides 0 to 5 vdc as the input signal. To measure this signal, dc voltmeter V3 has an accuracy of 1% on its 5 volt range. Wirewound or metal film resistors R1 (10 ohms) and R2 (980 ohms), each with a precision of 0.1%, in combination with the amplifier input resistance, produce an input across terminals 4 and 3 that varies from 0 to 50 millivolts when V3 indicates from 0 to 5 volts. Resistor R1 is also chosen to simulate the low source resistance typical of signal devices that are used with an amplifier gain of 100. Metal film resistor R3 (2K) provides a typical source resistance to the unity gain input of the amplifier. Metal film resistor R4 provides a representative output load on the amplifier and is also chosen to facilitate measurement of amplifier internal impedance; R4 is 100K; both R3 and R4 have 1% accuracy.

Null indicating instrument V1 is a sensitive voltmeter (such as Fluke Model 803) floating from ground (ground lug removed from signal terminals). While test conditions are being set up, V1 should be desensitized by being switched to high range; while measurements are being made, V1 is set to a millivolt range; V1 is then desensitized until more measurements are made.

Cathode-ray oscilloscope CRO monitors the output and indicates peak-to-peak values in the millivolt range.

The amplifier receives power from a single-phase 400 cps source, sine wave, free from even harmonics. Variable transformer T2 controls the input to the amplifier, normally 115 vrms, and 1:1 transformer T1 isolates the test circuit from ground. These transformers are each rated for 10 watts minimum. AC voltmeter V2 has an accuracy of 1% on its 150-volt range. The seven spst switches and the one spdt switch facilitate changing the circuit configuraton for different tests; each switch operates separately. If effects of line voltage are to be measured, T2 should change the input power from 104 to 126 vrms. If effects of temperature are to be measured, the amplifier should be mounted in a test chamber that can be controlled from +5°C to +45°C.

NULL TEST

To measure the null of the amplifier, open all switches. Warm up, calibrate, and zero null indicator V1. With V1 desensitized, operate the switches in this sequence: set S3 to Null, close S1, S6, S7, and finally close S5. Adjust T2 for 115 vrms power input. Read the amplifier null on V1; it should be less than ±5 millivolts for a change of power input from 104 to 126 vrms and for a change in environment temperature from +5°C to +45°C. After the test, desensitize V1, leave all switches as they are, and proceed with the next test.

RIPPLE AND NOISE

Open S6 and close S4. Observe the peak output ripple on the CRO. Ripple and noise should be less than 5 millivolts peak-to-peak. After the test open S4 and reclose S6.

LINEARITY AT UNITY GAIN

Continue the procedure by operating the switches as follows: close S2, S6, S7 and S5; open S1, S4 and S8; set S3 to Null. Accurately read the amplifier null indicated by V1, recording both polarity and magnitude. Desensitize V1. Set PS1 to approximately 4 vdc; set S3 to Gain, and close S8. With a screw driver, set the adjustment on top of the signal-conditioning amplifier to produce an indication precisely equal in polarity and magnitude to the null just recorded. While observing V1, slowly vary PS1 from 0 to 5 vdc. The null should not deviate by more than ±5 millivolts from the null to which the test circuit was just adjusted. Return PS1 to 0. Desensitize V1.

This test applies a signal that varies from 0 to 5 vdc across the amplifier input terminals 10 and 3 and requires that the output follow the input from zero to full scale to within ±0.1% of full scale.

GAIN STABILITY

With the same set-up as for linearity, set PS1 to 5 vdc. Adjust the power to 115 vrms and the ambient temperature to +25°C; record the indication of V1. When the power is varied from 115 to 126 vrms or from 115 to 104 vrms, the indication of V1 should not change from its initial value by more than 7.5 millivolts (0.15% of full scale). With the power set to 115 vrms, a change in environmental temperature from +20°C to +45°C should not change the indication of V1 from its initial value by more than 15 millivolts (0.3% of full scale). Desensitize V1.

AMPLIFIER OUTPUT IMPEDANCE

Continue with the set-up just used for stability measurement. Set PS1 to 5 vdc; open S7; leave the other switches as they were. Voltmeter V1 reading should change less than

75 millivolts, indicating that the internal output impedance of the amplifier is not greater than 1.5K, because the output voltage does not increase by more than 1.5% of 5 vdc when the 100K load is removed. Desensitize V1 and close S7.

LINEARITY AT GAIN OF 100

For this test, close S1, S7, S6 and S5; open S2, S4 and S8; set S3 to Null. Read accurately and record the polarity and magnitude of the null shown by V1. Desensitize V1. Set PS1 to approximately 4 vdc; set S3 to Gain, and close S8. Carefully set the gain of the amplifier by rotating its screw driver adjustment to produce precisely the same null just recorded. While observing V1, slowly vary signal PS1 from 0 to 5 vdc. The indication should not deviate by more than ±5 millivolts from the null to which the amplifier was initially adjusted. Desensitize V1 and return PS1 to 0.

The test just performed applies a signal that varies from 0 to 50 millivolts dc across amplifier input terminals 4 and 3 and requires that the output vary linearly with this input from zero to full scale within ±0.1% of full scale.

To measure other characteristics at a gain of 100, leave the switches in their positions for the linearity test; otherwise repeat the procedure previously followed for measurement of ripple and noise, gain stability, and output impedance.

COMMON-MODE REJECTION

In order that the test set-up does not mask performance of the amplifier, all socket terminals and wiring must be clean and dry. Isolate the input by breaking the tie between terminals 3 and 2. Open S2, S4, S5, S6 and S8; close S1 and S7; set S3 to Null.

Three different conditions are to be measured: common-mode interference of a dc voltage, of a 60 cps voltage, and of a 400 cps voltage.

Desensitize V1 and connect it directly across output terminals 7 and 2. Connect a floating 100 vdc power supply between terminals 3 and 2. Close S5 and turn on the dc supply. Record the indication of V1. Desensitize V1. Open S5 and turn off and remove the dc supply. Reconnect terminals 3 and 2; close S5 and again record the indication of V1. The difference between the first indication of V1 (with 100 vdc common-mode signal) and the second indication of V1 (without common-mode interference) should be less than 10 millivolts. Open S5 and disconnect V1.

Again break the connection between terminals 3 and 2 and connect the secondary of a 1:1 60 cps isolation transformer between terminals 3 and 2. Apply 115 vrms at 60 cps to the primary of this transformer; close S4 and S5. The deflection on the CRO should be less than 320 millivolts peak-to-peak (less than 115 millivolts rms at 60 cps). Open S5. Turn off the 60 cps power and disconnect the 60 cps isolation transformer.

Tie terminal 3 to terminal 8 thereby applying 115 vrms at 400 cps common-mode to the amplifier signal input. Close S5. The deflection on CRO should be less than 32 millivolts peak-to-peak (less than 11.5 millivolts rms at 400 cps). Open S5; the tests are completed.

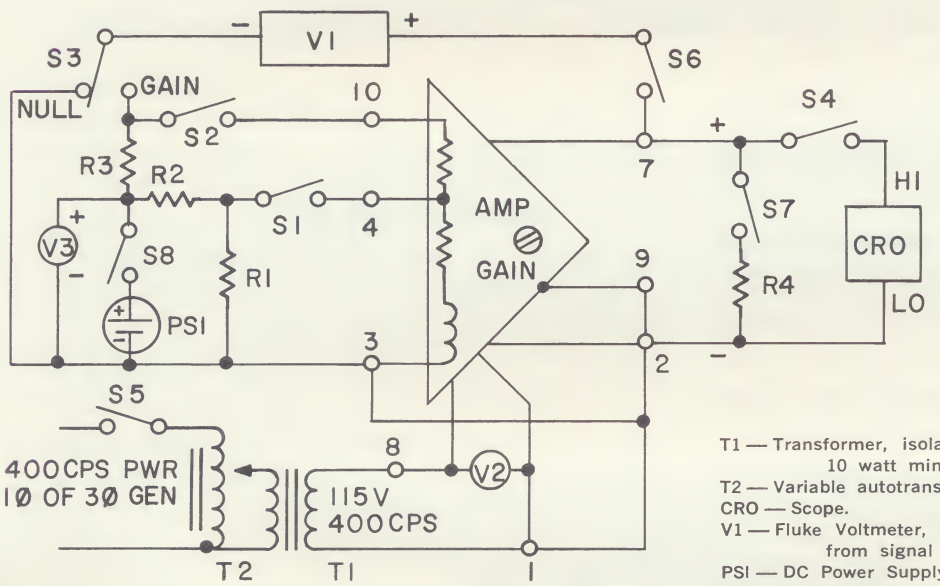
The following relation converts the rejection measurements to decibels:

$$R = 20 \log (EG/V)$$

where R is common-mode rejection in db, E is the applied common-mode interference in volts, G is amplifier voltage gain expressed as a ratio, and V is the voltage output from the amplifier as measured in the test set-up, in volts.

For example, at dc, the applied interference E was 100 volts, the amplifier was operated at a gain of 100, and the measured output was 10 millivolts or less. Let us assume that it was 10 millivolts, which is 0.01 volt. Then rejection R in db equals 20 log $\frac{100 \times 100}{.01}$ which is 120 db.

Similarly at ac and using vrms for consistency, R for the limiting specified rejection is 100 db at 60 cps and 120 db at 400 cps.



SCHEMATIC DIAGRAM
OF
TEST CIRCUIT

T1 — Transformer, isolation, power, one to one, 115V, 400 CPS, 10 watt min.
T2 — Variable autotransformer.
CRO — Scope.
V1 — Fluke Voltmeter, Model 803 or similar. Ground lug removed from signal terminals.
PSI — DC Power Supply, regulated, variable 0-5V DC.
V2 — AC Voltmeter, 150 volt scale, 1%.
V3 — DC Voltmeter, 0-5V DC.
R1 — Resistor, wirewound or metal film, 10 ohms, 0.1%.
R2 — Resistor, wirewound or metal film, 980 ohms, 0.1%.
R3 — Resistor, metal film, 2K, 1%.
R4 — Resistor, metal film, 100K, 1%.

NO MATTER HOW YOU TEST IT . . .

it performs like this!

- Null within ±0.1% of full scale
- Gain stability of ±0.15% of full scale maximum for ±10% change in power line voltage
- Voltage gain of 0 to 100, fixed gains of 1 and 100
- Guaranteed linearity of ±0.1% of full scale
- Common-mode rejection to a 100 volt interference:
  120 db minimum at dc
  100 db minimum at 60 cps
  120 db minimum at 400 cps
- Zero stability within ±0.1% of full scale for ±10% change in line voltage and simultaneous ±20°C change in ambient
- Typical gain stability of 0.01% of full scale per degree C from +20°C to +45°C
- 50 microamperes input produces full-scale output
- Response within 6 db from dc to 6 cps
- 5 vdc full-scale output
- 1000-megohm input isolation at 500 vdc
- ±10% built-in vernier gain adjustment
- 5 millivolts peak-to-peak maximum output noise and ripple combined
- Output can be short circuited continuously without damage
- Long-term zero stability within 2.5 microvolts referred to input
- Input tolerates 500 times full-scale current continuously
- Gain stability of 7.5 millivolts maximum referred to output for ±10% change in supply voltage from 115 vrms nominal
- Peak-to-peak noise and ripple combined no more than 0.1% of full scale
- 0 to 5 vdc output into 100K load
- Input tolerates 25 milliamperes continuous overdrive
- Typical zero stability 0.5 microvolt per degree C from +5°C to +45°C, referred to input
- Long-term gain stability within 0.1%
- 1K nominal input impedance for voltage gain of 100
- Resolution of gain trim 0.05%
- 1500 ohm maximum internal output resistance
- 0.005% long-term zero stability
- 101K nominal input impedance for voltage gain of 1
- Typical linearity to best straight line: 0.025% of full scale
- Typical common-mode rejection:
  140 db at dc
  120 db at 60 cps
  140 db at 400 cps
- Power: 115 volts ±10%, 400 cps ±5%, 2 volt-amperes
- Requires no dc power supply
- 11-pin plug-in base
- 11.5 ounces maximum weight

AIRPAX ELECTRONICS INCORPORATED

AIRPAX ELECTRONICS incorporated · SEMINOLE DIVISION, FORT LAUDERDALE, FLORIDA

PHONE: 305 587-1100 TWX: 305 - 587-1000

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